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Title SCALED MODEL TESTS OF THE KAVERI ENGINE 2D-CD THRUST VECTORING NOZZLE

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Abstract

Experimental studies were carried out using three rectangular (2D), Convergent - Divergent (CD) nozzle configurations having aspect ratio (AR) of 1, 2 and 4 with vectoring (pitch) angles (β) of 0°, 10° and 20°. Nominal design pressure ratio, for the nozzles tested, was about 3.9. Internal performance of these nozzles in terms of their discharge and thrust coefficients was determined for nozzle pressure ratios (NPR) varying from about 1.4 to 4.8, using high pressure air at ambient temperature. For a given geometry, the results obtained indicated that the nozzle performance was generally independent of the aspect ratio (within the range considered). However, at AR = 4, the nozzle performance decreased appreciably, especially at $\beta = 20^{\circ}$. The effect of vectoring angle on nozzle performance was felt for values exceeding 10° and was maximum at the highest aspect ratio studied. Also, within the range of aspect ratios considered, the performance of 2D nozzles could be considered as similar to an equivalent axisymmetric nozzle.It appears that an advanced engine providing a thrust to aircraft weight ratio significantly exceeding unity is required to exploit the advantages of thrust vectoring.

Nozzle internal flow computations (2D) were carried out using the PHOENICS code. The results obtained provided useful information on the quality of flow within the nozzle. Nozzle performance parameters computed by this code agreed well with the experimentally determined values when the NPR approached the design value. Surface oil flow visualisation studies were carried out on the inner walls of nozzle of aspect ratio 2. For a convergence angle of 30°, a small flow separation zone (with subsequent reattachment) was found to occur just downstream of the throat plane. In the vectored nozzle geometries, this separation zone was quite prominent on the top wall due to a sharp curvature at the throat plane. This resulted in local variations of the heat transfer coefficient distribution, the results of which are reported separately.